at 1-, 5-, 12-, 19-, 26-, and 39-day intervals after the treatment. Each time the dead parasites were counted, the food was replenished, and 10 additional specimens were added to each cage.

All treatments substantially reduced the infestation in shoots and fruit. Niagara 10242, at 1.5 and .5 lb per 100 gallons, gave the best results in controlling worms in the fruit—1.96% and 2.74% infestation respectively, compared to 20.64% in the untreated check—but its desirability for use in peaches diminishes because it induces an increase in the mite population. The next best treatment was with Guthion at 1.5 lb per 100 gallons, which reduced the infestation in the fruit to 3.84%, and controlled the mites efficiently—36.6 mites per leaf compared to 108.9 mites per leaf in the check trees.

All these chemicals, except Ryania and Biotrol, had a devastating effect upon the parasite *Phanerotoma flavitestacea*. The first survivors were found 24 days after the application in the plots treated with Geigy S13005 at ¼ lb per acre, but even then the percentage of mortality was very high (90%).

As Guthion is one of the most commonly used insecticides to control Oriental fruit moth and twig borer, a further test was run to measure the effect of reduced dosages upon the pests and the parasites. Three dosages (4.5, 2.25, and 1.125 lb/acre) were tested in non-replicated plots of 5 by 9 trees each. The chemical was applied with a Turbomist air blast sprayer in dilutions of 90 gallons per acre. The trees were sprayed May 28 and July 7. The parasite *Phanerotoma flavitestacea* was exposed to the insecticide after the second spray in the same procedure indicated previously. In the parasite test, three replicates per plot were run. The effect of the treatments on the pest, measured as percentage of fruit infested, was 0.1 for the high, 0.3 for the medium, and 0.7% for the low dosages. The high dosage of Guthion caused 100% mortality to the parasites for the 30 days the observation lasted, while in the plots treated with the lowest rate, the mortality dropped sharply after the 13th day, and after the 20th day it was comparable with the untreated check.

L. E. Caltagirone is Assistant Entomologist, and W. W. Barnett is Laboratory Technician II, Division of Biological Control, University of California, Berkeley. *This research was supported by grant funds from the Cling Peach Advisory Board.*

Controlling During

Rapid cooling after harvest, and continuing protection from heat during transit and marketing, are essential to avoid fruit shriveling and quality deterioration of sweet cherries. Delays of four hours or more between harvesting and cooling were particularly damaging, according to tests at Davis. Rapid cooling by forced air was found superior to slower methods in common use. Cherries exposed to hot, dry air during transit on open trucks lost weight rapidly in comparison to similar fruit protected by a wet canvas cover. Whenever excessive losses of moisture occurred, sweet cherries soon shriveled and became dull and unsightly.

W. C. MICKE

LOSS OF MOISTURE from fresh fruit can cause shrivel and reduce consumer appeal. Previous studies with nectarines have shown that weight losses of only 4 or 5% can impair fruit appearance. Furthermore, when weight losses occur after packing, fruit can loosen within the container, allowing movement and transit bruising. To study the effect of delayed cooling and adverse environmental conditions on sweet cherry quality and to determine the requirements of good handling procedures, a series of tests were made in 1964 and 1965. Particular attention was given to moisture losses during handling delays, in transit from the orchard to the packinghouse, and during cooling and holding.

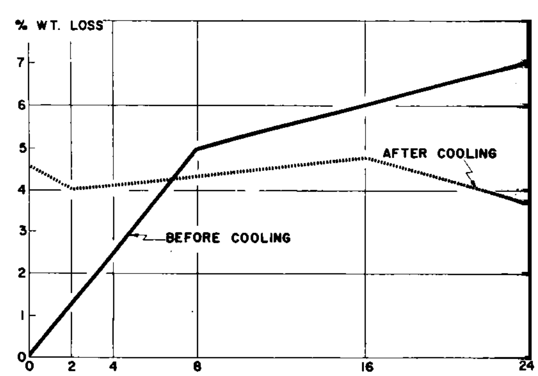
Delays before cooling

The effects of delays before cooling on weight loss and shrivel were studied during 1964. Fruit was obtained soon after harvest, sorted for defects and placed in wire baskets designed for accuracy in weighing. Delays between sorting and cooling were 0, 1, 2, 4, 8, 16 and 24 hours. Fruit was held at 80° to 86°F for the first eight hours of delay. For the two longer delay treatments (16 and 24 hours) fruit was held at 80° to 86°F for the first eight hours and was then placed at ambiant night and morning temperatures to simulate actual field conditions. Following the delay treatment, all fruit received rapid cooling and was then held for a simulated shipping period of five days at 39°F and a simulated marketing period of three days at 68°F. These samples were weighed periodically and all fruit was evaluated for deterioration at the conclusion of the test.

Moisture loss occurred rapidly during the first eight hours of delay before cooling (graph 1). As much weight was lost during this period as during the subsequent eight days of simulated shipping and marketing. The length of the delay before cooling and the amount of initial moisture loss had little effect on the amount of additional weight loss which occurred during the shipping and marketing period.

The effect of these cooling delays on visible fruit shrivel is shown in graph 2. Little shriveling could be detected in fruit cooled within two hours of harvest. However, the amount of shriveled fruit increased sharply from 8% after four hours' delay to 33% after eight hours' delay. Thus, serious shrivel was observed

GRAPH 1. EFFECT OF DELAYS ON WEIGHT LOSSES BEFORE AND AFTER COOLING BING CHERRY—1964



Weight Loss Sweet Cherry Marketing

F. G. MITCHELL GENE MAYER

TRANSIT OF CHERRIES FROM ORCHARD TO PACKING SHED
Part of the load was covered with a wet canvas, the remainder was uncovered.
(Distance—18 miles; time for trip 30–35 minutes.)

Location in Stack*	Boxes Covered or Uncovered	Per cent weight loss†	Temperature Increase†
Top	Covered	0.4	8.8° F
Top	Uncovered	1.2	17.5° F
3rd & 5th box from top	Covered	0.7	6.0° F
3rd & 6th box from top	Uncovered	0.6	6.8° F

* All boxes were in the 11th row back from the front of the truck.
† Each figure represents the average of two observations.

EFFECT OF RAPIDLY COOLING CHERRIES BY FORCED-AIR ON WEIGHT LOSS AND FRUIT SHRIVEL

Treatment*	Test Number	% Weight Loss Before Packing	% Weight Loss During Holding†	% Sound (Unshriveled) Fruit	% Shriveled Fruit	% Decayed Fruit
Rapid Cooling	1	0.5	2.9	67.7	31.5	0.8
Standard Cooling	1	3.0	3.2	51.3	47.0	1.6
Rapid Cooling	2	0.5	4.8	47.6	49.9	2.5
Standard Cooling	2	3.8	4.2	35.2	61.8	3.0

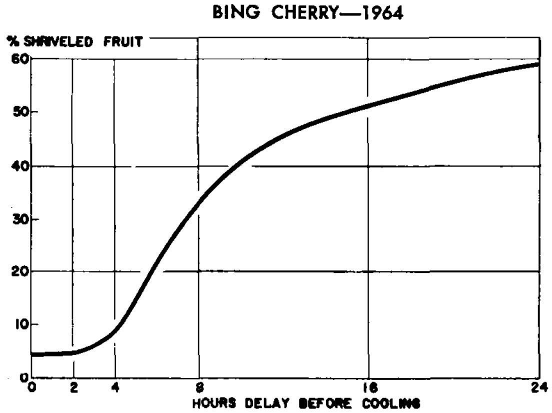
* Test 1 Rapid Cooling: fruit cooled to less than 40° F approximately 3 to 4 hours after picking and packed about 2 hours later. Standard Cooling: fruit was held at 86° F for about 9 hours after picking and was then packed and cooled.
Test 2 Rapid Cooling; fruit cooled to less than 40° F approximately 6 to 7 hours after picking and packed about 3 hours later. Standard Cooling: fruit was held at 70 to 86° F for about 16 hours after picking and was then packed and cooled.
† Fruit held at 38° F for about 5 days and at 68° F for 3 days to simulate shipping and marketing temperatures, respectively.

when fruit remained warm for four hours or more.

Transit of fruit

To avoid adverse effects of delays, fruit must be moved from the orchard to the packinghouse soon after harvest. Often during this transit, cherries are exposed to high velocities of hot air, which warm the fruit and cause additional moisture loss. To study the effects of covering the load with a wet canvas as one means of protecting this fruit, part of one load was covered. Temperature and weight-loss measurements were made for both the covered and uncovered fruit. The distance from the orchard to the packinghouse was 18 miles and travel time was 30 to 35 minutes. Covered fruit at the top of the load had lower temperatures and less moisture loss than uncovered fruit, as summarized above. The wet canvas apparently kept weight loss and temperature changes approximately the same throughout the load. Long delays in the open sun could cause heat to be trapped under the canvas and should be avoided.

GRAPH 2. EFFECT OF DELAYS BEFORE COOLING ON FRUIT SHRIVEL BING CHERRY—1964



Cooling

After arrival at the packinghouse, the fruit may again encounter long delays resulting in additional weight losses. The effect of rapid cooling to minimize fruit deterioration was evaluated during the 1965 season. Cherries were moved from commercial growing districts to Davis where part of the fruit was cooled rapidly to 40°F by forced-air and packed soon after cooling. Other fruit was held at 70° to 85°F for 9 to 16 hours before packing and cooling. These delays approximate those frequently occurring in the field and packinghouse. After packing and cooling all fruit was held at 38°F for five days and 68°F for three days, to simulate shipping and marketing temperatures. Weights were taken periodically during these studies, and samples were sorted for sound, shriveled, and decayed fruit at the conclusion of each test.

Prompt cooling with forced-air reduced weight loss by about 85% and the amount of shriveled fruit by 12 to 15% as compared with standard methods, as shown in the table. Weight loss during simulated transit and marketing did not appear to be affected by the previous moisture losses. In these tests, shriveling was a serious problem, even with short delays prior to cooling.

Conclusions

The results of these studies indicate that cherry moisture loss and fruit deterioration is a continuing process. Thus, protection against these losses must be applied at all stages of fruit handling. A relatively short initial cooling delay can cause more weight loss than subsequent shipping and marketing. This effect can be anticipated because of the higher temperature and lower relative humidity normally encountered during these delays in the field and packinghouse. Delays before cooling in excess of 4 hours caused a rapid increase in fruit shriveling.

From these tests it is evident that rapid cooling before packing can reduce the amount of weight loss and subsequent shriveling of fruit. Forced-air cooling rapidly removes field heat. If cherries are not allowed to warm substantially during packing, little supplementary room cooling will be needed. Fruit shriveling is the cumulative effect of moisture losses occurring during the various stages of cherry handling. If quality is to be maintained, attention must be given to all phases of cherry handling from harvest through marketing.

W. C. Micke is Extension Pomology Technologist; F. G. Mitchell is Extension Pomologist, Marketing; and Gene Mayer is Laboratory Technician, University of California, Davis. E. C. Maxie, Associate Pomologist; F. P. Guerrero, Assistant Specialist in Pomology; and J. T. Yeager, Superintendent of Field Cultivations, University of California, Davis, also cooperated in these studies.